DETERMINANTS OF HOUSEHOLD ELECTRICITY CONSUMPTION IN BAUCHI STATE, NIGERIA

Abubakar Hamid Danlami
Department of Economics, Faculty of Social and Management Sciences,
Bayero University Kano, Nigeria

Abstract:

Electricity is one of the major aspects of a household's welfare. This study was conducted with the main aim of assessing the factors that influences the amount of household consumption of electricity in Bauchi state, Nigeria. About 750 households were selected using cluster area sampling out of which 539 responses were analyses. OLS regression model was estimated to examine the impact of the household's socio-economic and demographic characteristics on their electricity use and consumption.

The result indicates that level of education of the household head, living in the urban areas of Bauchi State, price of firewood and number of energy use devices at home, have positive significant impact on the household use of electricity. On the other hand, marital status was found to have a negative impact on the electricity expenditure, the households that are headed by a married person have less expenditure on electricity than otherwise.

The study recommends policies that ensure increase in the level of education and turning some rural areas into urban areas will encourage adoption and use of electricity as a main source of household energy thereby reducing the rate of using traditional biomass energy.

1. Introduction

Electricity is one of the major aspects of a household's welfare, availability of electricity supply at a cheaper price means raising standard of living for household members. It is one of the key determinants of economic development (Zaman et al., 2012). Electricity has attained a very important place in every household on this planet. It is a major contributor towards improvement of the standard of living of individuals and households (Tewathia, 2014). The household consumption of electricity in Bauchi State can be categorized into three major dimensions namely; cooking, lighting and cooling purposes.

Additionally, in modern times, electricity source of lighting is regarded as one of the most efficient and most widely source of lighting especially in high income countries. However, in Bauchi State where mostly electricity supply is unavailable and unreliable, and also its costs is sometimes unaffordable, the alternative sources of lighting in some cases are from semi-electric sources like battery torch lights and rechargeable lanterns.

The most widely source of lighting, especially in the rural areas of Bauchi State consists of traditional sources of lighting which appear in the form of fuel-based lighting sources like oil lamps, candles, firewood and kerosene lamps. Such wider use of traditional lighting sources also aggravates the problem of indoor air pollution which increases the risk of respiratory diseases. Similarly, the use of candles and kerosene lamps inside homes increases the danger of fire accidents. Moreover, such traditional lighting devices do not give sufficient lighting situations for reading and studying which limit the capacity of literacy and school performance. For instance, a typical traditional kerosene lamp delivers only a useful light of in between 1 – 6 lumens per meter square (lux), compared to the required standard of 300 lux for tasks such as reading (Mills, 2003). The wider use of both the firewood (for cooking purposes) and the traditional sources of lighting are caused by many socio-economic characteristics of households in Bauchi State.

Factors like low income, low price of firewood and traditional lighting sources which made them easily affordable, low level of awareness on the dangers of the use of such type of energy, non availability and high price of electricity, as well as the culture of massive use of firewood in the environment encourage the adoption and use of firewood and the traditional sources of lighting. Therefore, it is very important to carry out an empirical study in order to provide up to date and relevant information on the households' electricity consumption pattern in Bauchi State, in order to improve their electricity consumption to the optimum level.

2. Literature Review

This section examines the various relevant previous studies conducted based on the variables estimated in this study.

Home Appliances: The number of energy consuming appliances at home, tends to increase the quantity of energy consumption by households. For instance, using OLS regression, Petersen (1982) investigated the determinants of variation in households' electricity usage. The variables that have significant positive impact on household electricity usage include; electric water heater, electric clothes dryer and dish washer. Similarly, a study to analyse the determinants of households' electricity use by Louw et al. (2008) found that ownership of iron has a significant positive impact in increasing the households' electricity use. However, Wang et al. (2011) concluded that subsidy for energy conservation appliance use encourages household electricity conservation behaviour. Moreover, Couture et al. (2012) concluded that households that possess wood burner and room heater have higher probability of adopting electricity as their main source of energy. Danlami et al. (2016) found that there is a negative relationship between home appliances and the adoption of electricity source of energy.

Price of Other Fuel: Various energy sources for household use are nearly close substitutes to one another, implying that the price of a particular household energy source influences the demand of other sources. A rise in the price of a particular energy source makes households to switch to the use of other fuels as established by previous studies (Lee, 2013; Mensah & Adu, 2013; Onoja, 2012). Moreover, Lee (2013) found that further rise in the price of firewood encourages households in both the urban and the rural areas to adopt non solid fuels. Similar argument was put forward by Mensah and Adu (2013) whereby the price of firewood was found to have positive influence on household fuel switching to electricity.

Marital Status: Laureti and Secondi (2012) indicates that households which comprise of couples with children tend to adopt more of coal-wood and less of electricity when compared with a household of a single person. On the contrary, a logit analysis by Danlami et al. (2016) found that there is a positive relationship between household head being male and the adoption of electricity source of cooking fuel. The household that is headed by a married individual has higher odd of adopting electricity fuel than otherwise.

Gender of the Household Head: Previous studies such as; Nlom and Karimove (2014), Jumbe and Angelsen (2010) and Osiolo (2010) proved no significant relationship between the gender of the household head and its energy consumption behaviour. However, Abebaw (2007) found that the household head being male encourages the consumption of fuel-wood. Furthermore, Mekonnen and Kohlin (2008) concluded that households with male head tend to adopt more non solid fuels than either solid or mixed solid and non solid. Moreover, Mensah and Adu (2013) found that household head being male discourages the household's adoption of cleaned energy. Similarly, a logit analysis by Danlami et al. (2016) indicated that there is negative relationship between a household head being male and the household adoption of electricity fuel source. A household that is headed by a female has higher odd of adopting electricity by about 3% compared to the male headed household.

Level of Education: Level of education of the household head has a positive relationship with the adoption of cleaned energy (like electricity). The higher educated is the household head, the more he realises the negative impact of un-cleaned energy and therefore the less it will be adopted. This assertion was found to be true by previous studies (Nlom & Karimove, 2014; Eakins, 2013; Mensah & Audu, 2013; Ozcan et al., 2013; Laureti & Secondi, 2012). Moreover, Lee (2013) concluded that level of education has a negative impact on the electricity consumption of households and that the higher the level of education of the household head, the higher the odd of adopting electricity source of energy instead of kerosene. Additionally, a multinomial logit analysis by Braun (2009) indicated that higher education of the household's head is associated with the adoption of more gas and less solid fuel and electricity. In the same vein, Laureti and Secondi (2012) concluded that the household that have a head who studied up to a degree level adopts more electricity and less LPG or coal-wood when compared with household where the head has diploma as the highest school level attended. Nlom and Karimove (2014) and Mensah and Adu (2013) found that the level of education of the household head encourages households switching to cleaner energy.

Household Size: The number of a household's members (i.e household size) affects the household's electricity consumption decision, the larger the size of a household, the lesser the cleaned energy to be adopted. This assertion was supported by previous studies (Ozcan et al., 2013; Mensah & Audu, 2013; Suliman, 2010; Heltberg, 2005). Onoja (2012) used two stages least square method to analyse factors influencing fuel-wood demand in Kogi state, Nigeria. The findings indicated that household size is positively related to the consumption of firewood. Lee (2013) found that household size have positive significant impact on the households' electricity consumption. Using the same OLS regression, Petersen (1982) concluded that family size, have significant positive impact on household electricity usage. The same conclusion was arrived at by Abrahamse and Steg (2009). Eakins (2013) established that number of adults in the home encourages households to adopt gas instead of electricity. Similarly, some studies (Abebaw, 2007; Jiangchao & Kotani, 2011; Song et al., 2012; Eakins, 2013) used Tobit model to analyse the impacts of households' sizes on their energy consumption. For instance, Jiangchao and Kotani (2011) analysed the determinants of households' use of electricity. The results indicated that the size of the household exacts a negative impact on households' consumption on electricity. Similarly, Braun (2009) indicated that as the number of households' members increases, the households increase the use of solid fuels and reduce the use of gas and electricity. Furthermore, higher education of the household's head is associated with the adoption of more gas and less electricity.

Location: The location of the home in which the households live have serious impact on their electricity consumption decision. The households that are located in urban areas tend to adopt cleaner energy (like electricity) than their rural counterparts. This was proved to be true by previous studies such as Eakins (2013), Ozcan et al. (2013) and Mensah and Audu (2013). For instance, Hosier and Dowd (1987) conducted an empirical test of energy ladder hypothesis in Zimbabwe. The results indicated that households living in urban area tend to use more electricity in relation to wood and kerosene. Suliman (2010) concluded that the location area in which household lives, exacts significant influence on their choice for cooking fuels. Households that live in urban areas adopt cleaner fuels than their rural counterpart. This is in line with the findings of Ozcan et al. (2013) whereby they concluded that households living in urban areas tend to adopt the modern energy sources (electricity) instead of firewood.

Home Size: The size of the residence in which households live influences their energy consumption behaviour. Similarly, Laureti and Secondi (2012) concluded that the larger the sizes of the home, the more households adopt oil and coal-wood and the less they adopt electricity. On the contrary, Tchereni (2013) found that there is a positive relationship between the home size and the adoption of electric source of energy. The higher the size of the home in which the household lives, the higher the probability of adopting electricity. Additionally, Danlami et al. (2016) found that adoption of electric source of fuel is positively related to the size of home in which the household lives.

Number of Rooms: The number of rooms in the house is one of the building characteristics which influence households' energy consumption choice. For instance, Eakins (2013) indicated that number of rooms in the house is positively related to household expenditure on energy from electricity. Furthermore, a logit analysis by Eakins (2013) to estimate households' fuel adoption between gas and electricity in Irish established that number of rooms in the home encourages households to adopt gas instead of electricity. Louw et al. (2008) concluded that number of rooms has significant impact in increasing the households' electricity use. Meanwhile, Danlami et al. (2016) asserted that the higher the number of rooms, the higher the odd of adopting electric source of fuel.

Based on the above reviewed literature, it was found that there exist inconsistencies as per the findings and conclusions by the previous studies on household use of electricity. The inconsistencies indicate that the results and findings of one study from a particular area cannot be generalised to another area due to socio-economic, cultural and environmental differences. Therefore, studying determinants of household electricity consumption in a new area is an additional contribution to the existing literature.

3. Theoretical Framework

The background of the analysis of this study is anchored on the traditional theory of demand. The law of demand states that the higher the price of any commodity, the smaller the quantity of such commodity that is purchased and the lower the price, the higher the quantity demanded (Tawiah, 2000). Moreover, the price of other commodity plays a role in determining the quantity demand of another commodity depending on the relationship between the commodities.

However, it is not only price that influence the quantity of demand for a commodity but also there are non-price determinants of demand such as; income of the consumer, taste and preferences, number of consumers, and the availability of substitutes. In its implicit form, the relationship between the quantity demand of a commodity and factors affecting it is expressed as:

$$Qx = f\left(P_X, Y, P_S, P_C, T, N\right) \quad (1)$$

where:

Q_x= quantity demanded

P_X= price of good X

Y = income

P_S = price of substitute

P_C = price of complement

T = preferences

N = number of consumers

Applying demand theory to the analysis of household energy demand, previous studies (Lee, 2013; Couture et al., 2012; Song et al., 2012) established a relationship between some factors and the quantity of energy demand. For instance, the impacts of some factors like; gender of the household head, education, marital status, home ownership, household size, number of rooms and location on the quantity of household consumption of electricity can be analysed using multiple linear regression model.

$$Y_i = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + u_i \quad (2)$$

$i = 1, 2, \dots, n$

Y_i = Quantity of electricity consumption

β_i= Coefficients

X_i= Various independent variables which can be in form of continuous or dummy

u_i = Unobserved error term

On *ceteris paribus* basis, other variables (determinants) can be held unchanged to observe the impact that a particular variable exacts on the quantity of electricity consumption.

4. Methodology

This section examines the approach adopted in the process of carrying out this study. It consists of the population of the study, sampling and sampling technique as well as the tool of data analysis used in the study.

4.1 Population of the Study

This study considers the households that live within the boundary of Bauchi State, Nigeria. The total estimated number of households as at 2014 was 769,960 (UNFPA, 2014). These households are spread in the three geopolitical zones of the State namely; Bauchi zone, Ningi zone and Katagum zone respectively.

4.2 Sample Size

After identifying the targeted population of this study, the next step followed was determining the sample size of this study. According to Bartlett, Kotrlik and Higgins (2001), sample size determination is common and usual task for many researchers, in that, it affects and influences the accuracy and quality of research. However, there is not specified percentage of the population set to be accurate for representation. What really matters is the number of the sample size and not a percentage of the study population (Jeff, 2001). Sekaran (2003) argued that when the sample size is too scarce, there will be prone of committing a type I error where the research rejects what should be accepted. On the other hand, too large sample size will lead to committing the type II error whereby the research accepts what should be rejected. Hence, neither too small nor too big sample size help in achieving accurate research conclusions. Roscoe (1975) give a rule of thumb for selecting a good sample size to be larger than 30 and less than 500 for most researches. And that in case of multivariate studies, the sample size should be at least 10 times as large as the number of variables. While, Bartlett et al. (2001) gave a rule of thumb for the accurate sample size of at least 5 to 10 times larger than the number of variables. According to Jeff (2001) the factors to be considered when choosing an appropriate sample size includes; the determined goals, the desired precision of findings, the confidence level, the degree of variability and the estimated response rate.

In this study, the total sample size used was determined based on Dillman (2011). According to Dillman (2011), the formula for determining a good representative sample is:

$$S = \frac{NP(1-P)}{(B/C)^2\,(N-1) + P(1-P)} \qquad (6)$$

where:

S= required sample size.

N= the population size (769,960)

P= the population proportion expected to answer in a particular way (the most conservative proportion is 0.50).

B= the degree of accuracy expressed as a proportion (0.05).

C= the Z statistic value based on the confidence level (in this case 1.96 is chosen for the 95% confidence level)

Therefore, the sample size can be determined as:

$$S = \frac{(769{,}960 * 0.5)(1-0.5)}{(0.05/1.96)^2(769{,}960-1)+(0.5)(1-0.5)} = \frac{192490}{501.067+0.25}$$

$$S = \frac{192490}{501.317} = 384$$

This determined sample size corresponds to what is contained in the sample size table by Dillman (2011) for 1,000,000,000 population size.

For the purpose of data collection for this study, a total of 750 questionnaires were distributed instead of the pre-determined sample number of 384 households. This was to avoid a problem of non response rate. Babbie (1995) argued that at least 50% rate of response is necessary for reporting and analysis (cited in Watson, 1998). Finally about 548 filled questionnaires were returned back, which is more than 70% of the total number of the issued questionnaires.

4.3 Sampling Technique

This study has adopted cluster area sampling method. According to Rao (2009), area sampling is a special type of cluster sampling whereby samples are grouped and clustered on the basis of geographical location areas. Area sampling is usually adopted where the research focuses on the population within a specific geographical area like country, state, county and city blocks (Valliant et al., 2013; Sekaran, 2003).

The reason for adopting this sampling method is that though the sampling frame for the various clusters of Bauchi State is available and was obtained from the National population commission office, there is no available frame containing the list of households living in Bauchi State. Hence in this situation, area sampling is one of the most suitable techniques of data collection. As argued by various scholars that the underlying practical motivation for using area sampling is the absence of complete and accurate list of the universal elements under study since it does not depend upon the population frame (Valliant et al., 2013; Rao, 2009; OECD, 2007; Sekaran, 2003).

The sampling technique used in this study is the multistage cluster sampling. In the first stage, the whole of the study area was divided in to three groups (clusters) based on the geo-political zonal categorisation of the State, the various categories are; Bauchi South, Bauchi Central and Bauchi North. In the second stage, two clusters (Bauchi South and Bauchi North) were selected randomly out of the three clusters. According to Saunders et al. (2009) and Kothari (2004), a researcher makes a random selection of some clusters to represent the total area under study.

In the third stage, these two clusters were further categorised into two sub clusters; urban and rural areas. Then a total of 10 wards were randomly selected from the urban areas while a total of 13 wards were selected randomly from the rural areas. This gives a total of 23 selected wards used as the sampling wards. In the fourth stage, six communities were selected randomly from each of the selected wards of urban areas which made a total of 60 communities from the urban areas. On the other hand, another six communities were randomly selected from the selected wards of the rural areas making a total of 78 communities used from the rural areas. This gives a total of 138 sampled communities used in the study.

In the last stage, six households were systematically selected from each of the selected communities of the urban areas making a total of 360 households selected from the urban areas. On the other hand, 5 households were selected systematically from each of the selected communities of the rural areas making a total of 390 households selected from the rural areas. Though finally, a total of 548 households participated in the study (i.e. the number of the returned questionnaires).

4.4 The Empirical Model

The main objective of this study is to assess the determinants of household electricity consumption. In this case, OLS regression model was employed to estimate the determinants of household consumption of electricity in Bauchi State. OLS model showing the relationship between dependent and independent variables can be expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_k X_k + U \quad (3)$$

The dependent variable Y and the independent variables (X_1, X_2, X_3 …, X_k) are perceptible irregular scalars, i.e. they can be observed in a random sample of the population. U is non observable random error and β_0, β_1, β_2..., β_k are the various parameters to be estimated. However, it should be noted that estimation using OLS technique is guided by some assumptions which include: linearity of the parameters of the model, zero mean of the random error (i.e E(U)=0). Homoscedasticity of the variance of the error term (i.e. ε N iid(0, σ^2). Zero covariability or relationship between the random error and the explanatory variable (i.e cov(X_j, U))=0, absence of specification error in the estimated model and the absence of perfect multicollinearity among the independent variables.

Following Petersen (1982) and Lee (2013); the implicit form of the relationship between households' consumption of electricity and its determinants can be expressed as:

$$Y_i = \beta_0 + \sum_{i=0}^{k} \beta_i X_i \qquad (4)$$

where; Y_i is household i's consumption of electricity.

The empirical estimated OLS model for households' electricity consumption is shown explicitly as:

$$\begin{aligned} ELEC_i &= \alpha_0 + \beta_1 HHGEND_i + \beta_2 MSTATUS_i + \beta_3 EDUHHH_i + \beta_4 HHSIZE_i \\ &+ \beta_5 LOCATION_i + \beta_6 HSIZE_i + \beta_7 UPFW_i + \beta_8 NROOMS_i \\ &+ \beta_9 NLFUEL_i + \beta_{10} HAPP_i + \varepsilon_{ij} \end{aligned} \qquad (5)$$

where:

$ELEC_i$= household i, monthly expenditure on electricity
$HHGEND_i$= Gender of the head of household
MSTATUS= Marital status of the head of household
$HHEDU_i$= Level of education of the head of household
$HHSIZE_i$= Size of the household
$LOCATION_i$= Home location of the household
$HSIZE_i$= Home size
$NROOMS_i$= Number of rooms in the home of household
$UPFW_i$= Unit price of firewood per bundle
$NLFUEL_i$= Similarity with the neighbour's main fuel source
$NHAPP_i$= Number of home appliances own by household

5. Discussion of Results

This section provides the discussion of the result obtained from the estimated OLS regression model. However, the result of the variable correlation matrix is presented before discussion on the estimated OLS model.

5.1 Correlation Analysis

In this section, a correlation analysis was conducted in order to explore the nature of the correlation that exist among variables used in this study, and also to ascertain whether there are two or more variables that explain the same phenomena (i.e. multicollinearity of variables). Usually, the value of correlation coefficient ranges between 0 - 1. A correlation value of 0.7 indicates high correlation among variables. Furthermore, a negative value indicates negative relationship between variables and a positive value indicates positive relationship between variables. Table 1 exhibits the correlation values for variables in this study.

Table 1: Variable Correlation Matrix

	ELC	GEN	MST	EDU	HHS	LOC	HSZ	PFW	NRM	NLF	HPS
ELC	1.00										
GEN	-0.002	1.00									
MST	-0.09	0.18	1.00								
EDU	0.19	0.07	0.02	1.00							
HHS	-0.07	-0.01	-0.02	-0.09	1.00						
LOC	0.27	0.01	-0.02	0.30	-0.14	1.00					
HSZ	0.03	-0.04	0.09	0.12	0.26	0.05	1.00				
PFW	-0.05	-0.07	0.002	-0.13	0.01	-0.36	0.03	1.00			
NRM	-0.13	0.01	0.001	-0.05	0.38	-010	0.36	-0.02	1.00		
NLF	-0.06	0.02	0.05	-0.12	-0.15	-0.08	-003	0.07	-0.06	1.00	
HPS	0.13	0.01	0.07	0.03	0.06	0.06	0.16	-0.02	0.10	-0.06	1.00

5.2 Determinants of Electricity Consumption in Bauchi State

The main objective of this study is to estimate the determinants of electricity consumption in Bauchi State. In this section, the result obtained from the estimation of electricity consumption is presented and discussed. The result of the estimated OLS model for electricity consumption is presented in Table 2.

Table 2: Estimated OLS Model for Household Expenditure on Electricity

VARIABLES	OLS
gender	0.027
	(0.287)
marital status	-0.364*
	(0.187)
education	0.026**
	(0.010)
household size	-0.001
	(0.014)
location	0.591***
	(0.173)
home size	0.001
	(0.003)
price of firewood	0.003*
	(0.002)
lnnumber of rooms	-0.162
	(0.109)
Neighbour lighting fuel	-0.094
	(0.207)
home appliances	0.013**
	(0.007)
Constant	1.640***
	(0.394)
Observations	350
R^2	0.11

Ramsey RESET Test (specification test)
F(3, 239) = 1.96
Prob > F = 0.1197

Note: Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Table 2 contains the result of the estimated OLS model for household electricity consumption in Bauchi State, Nigeria. The overall test statistic (F-value=9.86) of the model indicates that the estimated model is statistically significant at 0.1% (p-value = 0.000). Moreover, in order to further ascertain the validity of the model, various post estimation tests were conducted.

Test of Heteroskedasticity and Normality

The test of heteroskedasticity and normality were conducted using Cameron and Trivedi Im-test. The results of these tests are contained in Table 3:

Table 3: Cameron & Trivedi's Decomposition of IM-test

Source	X^2	df	P
Heteroskedasticity	52.05	61	0.7859
Skewness	13.73	10	0.1857
Kurtosis	2.27	1	0.1317
Total	68.05	72	0.6100

(Source: Author, 2016)

H_0: Homoscedasticity and normality.

The results of the heteroscedasticity and normality tests as shown in Table 3, failed to reject the null hypothesis of homoscedasticity and normality.

Test of Multicollinearity

Table 4 contains the VIF test for measuring the extent of multicollinearity among the independent variables.

Table 4: VIF Test of Multicollinearity

Variable	VIF	1/VIF
lnnumber of rooms	1.34	0.748
home size	1.32	0.757
location	1.31	0.763
household size	1.26	0.795
price of firewood	1.22	0.816
education	1.13	0.886
marital status	1.09	0.915
gender	1.08	0.924
home appliances	1.06	0.939
Nlfuel	1.05	0.948
Mean VIF	1.19	

(Source: Author, 2016)

Based on the result of the VIF test of variable multicollinearity shown in Table 4, since none of the VIF value reached a value of 10, there is no problem of multicollinearity among the included variables in the model and therefore, the study maintained all the variables for the purpose of estimation.

Specification Test

Here a test to see whether the estimated model is correctly specified or not. The specification test was conducted using Ramsey RESET test. The result of this test is shown in Table 2.

Based on the result of the model specification test, the null hypothesis that; the estimated model has no omitted variables was not rejected, and therefore, the model is correctly specified. The discussion of result and interpretation of variables estimated on the model of household electricity consumption are:

Marital Status: The result of the estimated OLS model in Table 2 has shown that this coefficient is statistically significant at 10% level. The result further shows that there is a negative relationship between this variable and the expenditure on electricity. The household that are headed by a married individual have less expenditure on electricity by about USD1.35 (₦365) lower compared to the household whereby the head is not married. This result does not conform to a priori expectation, because the expectation is that households that are headed by a married person have higher expenditure on electricity due to the fact that they are larger in size requiring higher expenditure on electricity than otherwise. However, the justification of this finding is that a married household head normally have more responsibilities on him than the single one, the condition which may make him to have lower budget on electricity consumption than the non married household head especially the fact that the people of the study area practice polygamy marriage system which makes them to have more responsibilities to shoulder leading to the cutting down of expenditure on electricity to other basic life necessities. This finding corresponds to the findings of Cayla et al. (2011).

Education: The result in Table 2 has shown that this coefficient is statistically significant at 5% level. Based on the estimated OLS result, an additional one year level of education attainment by the household head increases the household monthly expenditure on electricity by about USD0.09 (₦26) when other variables are held constant. This is tally with a priori expectation, because higher education level means higher income which results in increase in expenditure on electricity. Furthermore, the higher the level of education attained by the household head, the higher the minimum living standard to be maintained by the household leading to the rise in the household expenditure on electricity. This finding supports the findings of previous studies (Lee, 2013; Labandeira et al., 2010).

Location: The result in Table 2 has shown that this coefficient is statistically significant at 1% level. Based on the estimated result, households that are living in the urban areas have higher monthly expenditure on electricity than those living in the rural areas by about USD2.14 (₦600) when other factors are held constant. This conforms to a priori expectation because expenditure on electricity tends to be higher for urban dwellers than for rural dwellers due to so many reasons. Firstly availability, the number of hours in which electricity is available in urban areas is higher than that of rural areas which make the expenditure on electricity in the urban areas higher. Secondly, the electrical appliances own and use by households living in the urban areas far outweigh that of those living in rural areas which result in higher expenditure in the urban areas than the rural areas. Lastly, affordability, the households living in urban areas mostly have more income than those living in the rural areas and therefore afford to pay more on electricity consumption than those living in the rural areas. This finding corresponds to the earlier findings of previous studies (Eakins, 2013; Labandeira et al., 2010; Diabi, 1998).

Price of Firewood: The result from the estimated model in Table 2 has shown that this coefficient is statistically significant at 10% level. The result has shown that there is a positive relationship between the household expenditure on electricity and the price of firewood. Based on the estimated coefficient; a USD0.04 (₦10) increase in the price of firewood bundle leads to increase in the household expenditure on electricity by about USD0.11 (₦30) when other factors are held constant. This is tally with a priori expectation because in most cases especially for cooking purposes, firewood and electricity are close substitute hence as the price of firewood rises, households switch to the consumption of electricity by increasing their expenditure on the electricity. This is tally with the findings of Svoboda and Br (2013) and also in line with the argument of the theory of demand, that the price of a commodity has a positive relationship with the amount of quantity demand of the other close substitute good, so that as the price rises, people substitutes to the consumption and use of the other commodity or service.

Home Appliances: This variable represents the number of home electrical appliances such as bulbs, fluorescents, televisions, radio, refrigerators etc, possess at home measured in terms of number of unit quantity. Based on the estimated result, this variable was found to be statistically significant at 5% level. The result has shown that an addition to the stock of electrical appliance use at home, brings about increase in household expenditure on electricity by about USD0.05 (₦13) when other factors are held constant. This is in line with a priori expectation, because the higher the number of electrical device owned, the higher the consumption of electricity, consequently the higher the expenditure on electricity. This finding is tally with the findings of some previous studies (Eakins, 2013; Louw et al., 2008; Petersen, 1982)

6. Conclusions and Recommendations

This study was conducted with the main aim of examining the factors that influence household electricity consumption in Bauchi State, Nigeria. OLS regression model was used to achieve the stated objective. The dependent variable is the average monthly expenditure on electricity for the household. The study found that the higher the level of education of the household head, the higher the level of expenditure on electricity. Similarly, households that are living in the urban areas of Bauchi State have more expenditure on electricity than those living in the rural areas.

Price of firewood was found to have a positive significant relationship with the electricity consumption. Similarly, the study found that the higher the number of energy use devices at home, the higher the amount of electricity expenditure.

Contrarily, marital status was found to have a negative impact on the electricity expenditure, the households that are headed by a married person have less expenditure on electricity than otherwise.

However, the variables that were found to have insignificant relationship with the household expenditure on electricity are; gender, household size, number of rooms and home size. Therefore, the study recommends policies that ensure increase in the level of education and turning some rural areas into urban areas will encourage adoption and use of electricity as a main source of household energy thereby reducing the rate of using traditional biomass energy.

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